APPLIED RESEARCH BRANCH

Strategic Policy

Is Post-Secondary Education in Canada a Cost-Effective Proposition?

W-01-9E

by
John Appleby, Maxime Fougère, Manon Rouleau

June 2002

Working Paper

Human Resources Development Canada
Développement des ressources humaines Canada

Canada

SP-504-06-02E

104-00243/

Applied Research Branch
Strategic Policy
Human Resources Development Canada

Is Post-Secondary Education in Canada a Cost-Effective Proposition?

W-01-9E

by
John Appleby, Maxime Fougère, Manon Rouleau
June 2002

The views expressed in papers published by the Applied Research Branch are the authors' and do not necessarily reflect the opinions of Human Resources Development Canada or of the federal government.

■

The Working Paper Series includes analytical studies and research conducted under the auspices of the Applied Research Branch of Strategic Policy. Papers published in this series incorporate primary research with an empirical or original conceptual orientation, generally forming part of a broader or longer-term program of research in progress. Readers of the series are encouraged to contact the authors with comments and suggestions.

═

Paper/Papier
ISBN: 0-662-33422-1
Cat. No./N° de cat.: MP32-28/01-9E

Internet
ISBN: 0-662-33423-X
Cat. No./N° de cat.: MP32-28/01-9E-IN

General enquiries regarding the documents published by the Applied Research Branch should be addressed to:

Human Resources Development Canada
Publications Centre
140 Promenade du Portage, Phase IV, Level 0
Hull, Quebec, Canada
K1A 0J9

Facsimile: (819) 953-7260
http://www.hrdc-drhc.gc.ca/sp-ps/arb-dgra

Si vous avez des questions concernant les documents publiés par la Direction générale de la recherche appliquée, veuillez communiquer avec:

Développement des ressources humaines Canada
Centre des publications
140 Promenade du Portage, Phase IV, niveau 0
Hull (Québec) Canada
K1A 0J9

Télécopieur : (819) 953-7260
http://www.hrdc-drhc.gc.ca/sp-ps/arb-dgra

Abstract

This study provides an overview of the return on investment to post-secondary education in Canada, by gender. In it, three time series are developed respectively on the cost-effectiveness of non-university post-secondary diplomas (1981-1996), bachelor's degrees (1989-1996) and university degrees (1981-1996), including bachelor's, master's and doctoral degrees. The method used is based on a calculation of internal rate of return (cost-benefit approach) and is applied to the data from the Consumer Finance Survey.

The results as a whole indicate that rates of return to post-secondary education are positive and vary by gender and level of education. The results are also consistent with those of Canadian studies on rate of return to education over a single year. In addition, the analysis indicates that rates of return are sensitive to the state of economic activity, and there is a positive correlation between rates of return and unemployment rates. Lastly, after screening the data to adjust for the effects of the economic cycle, we identified a slightly positive trend in rates of return to university degrees. According to our estimates, the trend rates of return increased by approximately one percentage point between 1981 and 1996.

Acknowledgements

The authors wish to thank Dan Boothby, Christian Dea, Mario Lapointe, Jerry Lawlis, Clément Lemelin, Daniel Parent and Richard Roy for their judicious advice and meticulous revision of this paper.

Table of Contents

1. Introduction **1**

2. Rate of Return to Education: Concepts and Definitions **3**

2.1 Conceptual Questions 3

2.2 Definitions 4

3. Methodological Questions **7**

3.1 Method of Estimating Rate of Return Using the Earnings Function 7

3.2 Calculating the Ratio of Discounted Net Benefits to Total Costs 8

3.3 Method Based on Calculation of Internal Rate of Return to Education (Cost-Benefit Approach) 8

4. Review of Main Recent Empirical Studies in Canada **10**

5. Methodological Approach Adopted: Cost-Benefit Analysis **14**

5.1 Methodological Framework 14

5.2 Data and Definitions 15

5.2.1 Definition of Benefits 15

5.3 Indirect Costs 16

5.4 Direct Costs 17

5.5 Rate of Return and Economic Situation 17

6. Findings **19**

6.1 Changes over Time in the Cost-Effectiveness of Education by Level of Education 19

6.2 Correction for Effects of Economic Cycle and Trend 25

6.3 Variability of Results by Gender 27

Appendix A 31

Appendix B 32

Bibliography 35

1. Introduction

At one time or another in pre-adult life, individuals must decide on a career and determine whether to obtain a post-secondary education or to enter the labour force. Provided benefits are greater than costs, the decision to invest in an education is a desirable one since it increases the likelihood of finding more highly paid employment in the future. Investment in human capital also helps to increase the collective wealth of the nation by playing a dual role in the process of economic growth. First of all, human capital is a factor of production to the extent that it constitutes a stock of skilled labour. Second, since it represents an accumulation of knowledge, human capital is a source of innovation and one of the main causes of economic growth. Improved knowledge and skills also enable workers to perceive technological change more clearly and to adapt to it more effectively. In addition, in the context of globalization and the new knowledge economy, in which technological change is increasingly rapid, it can be expected that labour demand pressures will require a more educated and skilled work force.

One of the major factors influencing a student's decision to obtain a post-secondary education is the return associated with that education, that is to say the private rate of return accruing to a post-secondary degree or diploma. Although students do not actually calculate that rate of return, they tend to react to changes in the factors of the rate of return and to the differences between the various training disciplines.

In this study, we provide an overview over time of the private rate of return on investment in post-secondary education for men and women in Canada.[1] We develop three time series concerning respectively the return on investment in non-university post-secondary diplomas (1981-1996), bachelor's degrees (1989-1996) and university degrees including bachelor's, master's and doctoral degrees (1981-1996). Findings are generated with the aid of data from the Consumer Finance Survey (CFS).

[1] Out of a concern for clarity, our measure of rate of return to university education (including bachelor's, master's and doctoral levels) and non-university post-secondary education could be characterized as a "hybrid" of private and social rates of return since additional employment income and opportunity cost are calculated before tax. However, the measured rates of return to a bachelor's degree are private since they are calculated on after-tax incomes (for details on the calculations and the reasons therefore, see Appendix B (B.3))

This study is also part of an extensive project designed to gain a better understanding of the determining factors in the education-to-work transition process. For example, again within that framework, *Appleby et al.* (2001) examined the allocation of rates of return to education by field of study with the aid of Statistics Canada's life cycle, or as it is commonly called, "LifePaths" model.

Until quite recently, most studies that attempted to estimate private rate of return were based on findings obtained for a single year. However, since the decision to invest in human capital is a long-term decision, it is preferable to evaluate rate of return based on an average of a number of years rather than rely on a single year. The estimation of a sufficiently long time series also makes it possible to better isolate the impact of the economic cycle on the measured private rate of return. For example, in a period of economic slowdown or in a recession, the opportunity cost or indirect cost in terms of foregone earned income tends to decline, thus helping to temporarily increase the private rate of return to education. Furthermore, since, according to current approaches, measured future income is virtually equal to present observed income, unfavourable economic conditions could also influence the measured benefits of education. Lastly, estimating a time series makes it possible to evaluate changes in rate of return over time, that is to say to determine whether the rate of return to education in Canada tends to remain constant, to rise or to fall.

The structure of this paper is as follows. In Part 2, we examine the conceptual questions related to the rate of return to education and consider various definitions. In Part 3, we discuss the main methods used to measure the rate of return to education. Part 4 provides a brief review of empirical studies on the question. Then the methodological approach, assumptions and basic concepts used are discussed in Part 5, and our findings are set out in Part 6. Lastly, in the Conclusion, we summarize study highlights and make some suggestions for future research.

2. Rate of Return to Education: Concepts and Definitions

2.1 Conceptual Questions

According to the human capital theory applied to investment in education, a student may be viewed as an entity or a firm possessing an initial knowledge level or stock of human capital. Just as a firm may invest to accumulate physical capital, students may increase or improve their stock of human capital through activities such as education. Education increases the individual's productive capability by improving ability, skills and knowledge. The inputs used for the production of human capital include the resources available in the market (R), the time allotted by the student (T) and the student's initial stock of human capital (H_0). This enables us to define the following human capital production function:

(1) $h = h(R, T, H_0)$.

Human capital production costs depend on the opportunity cost (w) of the time spent on education and on the price (p) of a unit of resources available in the market. Assuming that C_0 corresponds to the initial cost of information and other fixed costs, the total cost of education function may be defined as follows:

(2) $C = C_0 + pR + wT$.

Lastly, the student's decision to invest in education may be viewed as an investment project that will be assessed on the basis of anticipated costs and benefits. The anticipated net present value (VNP^a) of investing in education is determined by:

(3) $VNP^a(R,T) = F^a + \rho^a * h(R, T, H_0)/i - C$,

where F^a represents anticipated financial assistance, ρ^a the anticipated return of a unit of human capital and i the discount rate.

A high level of education that continues to rise offers considerable benefits for individuals and society. The benefits of education for the individual are numerous. First of all, a post-secondary education increases the likelihood of earning a higher income than that of a high school graduate. A post-secondary education also leads to greater employment opportunities, higher performance and better working conditions. Lastly, the attraction of knowledge results in higher personal satisfaction, as a result of which education may be considered, to a certain degree, as a consumer good. From the standpoint of the community, increased levels of education raise national economic production, by increasing productivity and worker quality, while contributing to technological progress. In fact, a number of recent empirical studies suggest that the knowledge, ability and technical skills of the work force are significant decisive factors in a country's economic performance. From a social standpoint, higher education levels make it possible, among other things, to reduce poverty and dependence on the state since income earned depends on individuals' ability to contribute to national production and to reduce the crime rate. In other words, education helps create greater social cohesiveness.

2.2 Definitions

Reference may be made to three concepts of rate of return to education: social, public and private. Table 1 compares the components of the social, public and private rates of return.

The *social* rate of return serves as a point of reference for government authorities in determining whether it is financially cost effective, from the standpoint of society as a whole, to promote access to a given level of education. If, for example, at the community level, the social rate of return to training statisticians is 20%, it is advantageous to promote that discipline. This indicator, however, does not yield the order of magnitude of the desirable investments. The social rate of return compares the resources committed to education and the additional production observed at the community level. In particular, it takes into account the additional production expected when the general level of education rises. It is estimated on the basis of the additional employment income (before taxes) of the most highly educated.[2] Direct costs represent the total value of wages paid to teachers and the maintenance expenses of establishments as well as the cost of capital. Indirect costs are the total value of goods and

[2] The assumption being that compensation is equal to the value of marginal productivity.

services not produced. They are represented by the total value of gross income not received by full-time students.

The *public* rate of return measures the cost effectiveness of education from the standpoint of government. More specifically, it indicates the proportion in which tax revenues exceed the costs that must be borne to support services provided in education. The benefits represent the total value of taxes collected on the additional income of the most highly educated. Direct costs are subsidies paid to educational institutions and students. Indirect costs represent taxes not collected during the training period.

The *private* rate of return pertains to an agent in particular. It indicates whether it is desirable for an individual to rise to one level of education rather than another. The private rate of return concerns every person who must make a first or new career choice. The benefits associated with one level of education rather than another represent the difference between the respective incomes anticipated during the period of working life in the labour market. Direct costs comprise tuition fees and other expenses paid, in particular to purchase books. Indirect costs do not represent an additional sum that must be paid but are equivalent to employment income not received during the training period. Financial assistance paid to students partially offsets the value of disbursements.

The decision to study beyond the minimum level required may depend, in particular, on individual skills (genetic background or skills previously acquired in the labour market), the nature of values conveyed by the living environment (perceptions of work, professional model projected by parents, etc.) or the financial viability of education. This study focuses solely on this last aspect.

Table 1
Comparison of the Various Concepts of Rate of Return to Education

AGENT	SOCIAL The Community	PRIVATE The Student	PUBLIC (fiscal) Governments
Costs	**Direct costs**: Total value of education expenses: salaries paid to teachers, maintenance expenses of institutions and cost of capital **Indirect costs**: Total value of goods and services not produced (approximated by the total value of gross income not received)	**Direct costs**: Total value of tuition fees and related expenses **Indirect costs**: Income not received (net of tax) during training (opportunity cost) Less Financial assistance to the student	**Direct costs**: Subsidies paid to students and institutions **Indirect costs**: Value of taxes not collected on income foregone during training
Earnings	Additional production for all of society, approximated by the additional gross earnings received by the most highly educated (including all private benefits)	Additional earnings (net of tax payable) received by a post-secondary graduate compared to those of someone with a lower level of education	Total value of tax collected on additional earnings received by the most highly educated.

Source: Lemelin (1998).

3. Methodological Questions

There are at least three main methods for evaluating the cost-effectiveness of education.[3] The first is to estimate the earnings function, and this method has two variations: simple and more elaborate. The second is the net present value method. Lastly, the third is based on a calculation of the ratio of discounted net benefits to total costs. Although the three methods appear to be different from one another, they are nevertheless equivalent when it comes to measuring average benefits. In this section, we propose to discuss briefly each of the three major methods for calculating the rate of return to education.

3.1 Method of Estimating Rate of Return Using the Earnings Function

This method, developed by Mincer (1974) and also called the "Mincer function", uses econometric techniques to estimate the private rate of return to education. This method is one of the most popular used. The first variation of this approach, the simple method, consists in estimating a semi-logarithmic regression, in which one regresses the logarithm of income over the years of study, age or experience in the labour market. The estimated coefficient associated with the years of study represents the marginal effect of one additional year of education on labour income or, in other words, the rate of return of an additional year of education.

The main advantage of this method is that it is relatively easy to use and provides information on the strength of results. However, it does have certain deficiencies. In particular, Mincer's simple method presupposes that the marginal return is the same for each of the years of education.

To offset this disadvantage, the second, so-called "more elaborate" variation of the Mincer function consists in estimating the rate of return to education by distinguishing between years of education completed, or the last level of education attained, by graduates, based on a series of dichotomous variables. Once the earnings function is estimated, the rate of private return associated with the various levels of education can be derived by comparing the adjacent coefficients of the dichotomous variables.

[3] We do not discuss the so-called "short-cut" approach, since that method is no longer often used in the literature. For more information on this approach, see Cohn (1997) and Psacharopoulos (1994).

There is at least one other disadvantage to the Mincer method. It presupposes that the education variable is exogenous. However, a number of factors such as individual aptitudes and social characteristics may be important in determining level of education and earnings. By not taking these factors into account through a simultaneous regression approach, one risks skewing the estimation of the rate of return to education. In fact, one convincing way to calculate the causal effect of education would be to have a valid instrument, that is to say a variable which is exogenously associated with a higher level of education, but which has no independent effect on income. This is what Lemieux and Card (2001), among others, do in their estimate of the rate of return to education for Canada using the "Canadian G.I. Bill".

3.2 Calculating the Ratio of Discounted Net Benefits to Total Costs

This method consists in calculating the present value of the after-tax benefit associated with obtaining a post-secondary degree or diploma and the cost of a post-secondary education taking into account tuition fees, the cost of books and equipment and after-tax labour income forgone if one chooses to get an education rather than work. The ratio of discounted net benefits to total costs is then calculated. It should be noted that this method does not measure the internal rate of return to education. It is initially based on an assumption regarding the value of the discount rate on the basis of which it generates a ratio of discounted net benefits to total costs. In addition, like the Mincer method, it does not reflect abilities or environment.

3.3 Method Based on Calculation of Internal Rate of Return to Education (Cost-Benefit Approach)

This method is comparable to that of computing the profitability of a financial asset. It consists in using income profiles based on age and level of education and calculating the discount rate which evens out the stream of net benefits from a post-secondary degree or diploma relative to the flow of inherent costs (tuition fees, foregone labour income during the training period):

$$(4) \qquad \frac{C_{S-D+1}}{(1+R)^{S-D+1}} + \ldots \frac{C_S}{(1+R)^S} = \frac{B_{S+1}}{(1+R)^{S+1}} \ldots \frac{B_{S+N}}{(1+R)^{S+N}},$$

where C represents the direct and indirect costs of earning a post-secondary degree or diploma, B the net benefits from possessing a post-secondary degree or diploma, R the discount rate or

internal rate of return, S the anticipated age at the end of post-secondary studies, D the duration of the training period and N the duration of working life.

It can be said that this method, which is based on the financial aspects of the cost-effectiveness of education, is the most elaborate of the three because it requires the use of detailed information on income profiles by age and level of education attained. It also has the advantage of being easy to conceptualize since it simulates the profile of annual benefits received throughout an individual's working life and retains the inherent cost component. However, this approach, too, is not without the major disadvantage of the Mincer method, that is to say that it overlooks the effects of ability and environment.

4. Review of Main Recent Empirical Studies in Canada

There is an abundance of studies examining questions relating to the rate of return to education. In this part, we review a few recent empirical studies conducted in Canada which deal with the rate of private returns to education.[4]

Among the recent studies, Lemelin and Prudhomme (1994) estimated the private rate of return associated with obtaining a university degree compared to a high school diploma in Quebec, over six years, between 1981 and 1987,[5] using the internal rate of return of education approach. In their findings, Lemelin and Prudhomme (1994) observed among other things that the private rate of return appeared to have varied inversely to the economic cycle. It apparently rose during the 1981-1982 recession, peaking at 16% in 1982, and declined during the period of expansion, hitting a low of 12% in 1987. In view of the apparent sensitivity of the rate of return to the economic cycle, Lemelin and Prudhomme (1994) concluded that it was dangerous to infer any strong trends from a comparison of rates calculated over a limited number of years.

Stager (1996) conducted a study of the private rate of return for nine major fields of study for Ontario university graduates in 1990. He also looked at men and women separately. First, he found that the rate of return varied greatly by field of study and by gender. With the exception of medicine, women's rate of return was much higher than that of men. For men, the private rate of return was highest in medicine (20.8%), followed at a distance by commerce (16.2%), engineering (16%), mathematics and physical sciences (15.1%), law (15%) and other health professions (14.9%). The least cost-effective areas for men were biology (6.8%), the humanities and the arts (7.3%) and the social sciences (12.8%). For women, the highest private rate of return was in (21.8%), followed very closely by mathematics and physical sciences (21.2%) and the other health professions (21%), and at a much greater distance by engineering (19.8%) and medicine (19.7%). The least profitable fields were the humanities and the arts (14.8%), biology (15%), law (16%) and the social sciences (17%).

[4] Vaillancourt (1995) provides a survey of the literature including studies conducted between the early 1970s and the early 1990s.

[5] Except for 1983, when the Consumer Finance Survey was not conducted.

The OECD (1998) evaluated the private and social rates of return of nine of its member countries, including Canada, for 1995. The evaluation method used was the same as in the previous studies. However, there were certain differences with regard to the type of data used as well as the nature of the assumptions made. The benefits considered included income from employment and income from other sources. An annual productivity growth rate of 1% was applied to the earnings profiles to reproduce the gradual introduction of new technologies into the economy. Public subsidies paid to students were considered as a source of income, whereas the other authors did not include financial assistance in calculating returns to education. In addition, in computing mean income, the OECD considered the likelihood of experiencing periods of unemployment in working life. Source deductions from wages (contributions to employment insurance and the Quebec and Canada pension plans) were also included. The findings regarding rates of return to university education for various countries in 1995 are reproduced in Table 2.

According to the OECD study, the private rate of return was higher in France for men (20%) and women (28%) and lower in Denmark (8% and 7% for men and women respectively), followed by the United States (11% and 12%). Australia, Belgium and Canada had similar private rates of return for men (14%) and more variable rates for women (21%, 8% and 21% respectively for those three countries). The study also showed that, on the whole, the private rate of return was higher than the social rate of return, not a surprising result in view of the fact that the countries under study have publicly funded education systems. Since the level of public funding generally rises with the level of education, this has regressive policy implications.

Using the method of calculating the ratio of discounted net benefits to total costs, Allen (1998) evaluated the return to education for bachelor's degree holders from British Columbia based on 1991 census data. The ratios showed the extent to which discounted benefits exceeded costs assumed. The indices of seven university-level fields of study were also compared. He found a ratio of discounted net benefits to total costs of 2.7 for men and 3.1 for women. For women, the ratio varies between 6.5 for health, excluding the nursing profession, to 1.4 for the arts. For men, the ratio varied between 3 for mathematics and physical sciences to -0.15 for the human sciences.

Table 2
International Comparison of Private and Social Rates of Return of University Degrees (1995)

Member country	Rate			
	Men		Women	
	Private	Social	Private	Social
Australia	14	11	21	13
Belgium	14	9	8	9
Canada	14	9	21	11
Denmark	8	8	7	8
France	20	13	28	13
Sweden	ND	9	ND	7
United States	11	10	12	11

Source: OECD (1998)

Vaillancourt (1998) evaluated the private rates of return to education in Canada for 1985 and 1990 using the internal rate of return method and census data. Private rates of return were also calculated by gender, level of education and field of study. His findings may be summarized as follows. (1) The highest public and private rates of return resulted from obtaining a high school diploma, although that return had dropped since 1985. (2) The private rates of return of women tended to be higher than those of men. Rates of return rose slightly from 1985 to 1990 for men with bachelor's degrees and declined slightly for women. (3) Rates of return tended to decline by level of education attained, which is consistent with the theory of diminishing returns to education. The author noted, however, that this result could be misleading if used as a guide for public funding. There are other benefits associated with education, according to the author, such as participation in democratic institutions and other growth-generating externalities which increase with education. (4) The rates of return to the university level varied by field of study, the highest returns being in medicine and the lowest in the humanities. It is worthy of note here that the variation in the rate of return depends not only on income differences by field of study, but also, among other things, with abilities and duration and intensity of studies.

The Ministère de l'Éducation du Québec (2000) published a bulletin on the cost-effectiveness of a post-secondary degree and assessed the private rate of return associated with obtaining a bachelor's degree. The method used was the internal rate of return approach. According to the study findings, in Quebec, the private rate of return was 11.4% in 1990-1991 and declined to 9.5% in 1995-1996.

Lastly, Vaillancourt and Bourdeau-Primeau (2001) published an update of the findings of Vaillancourt (1998) on the private and total rates of return to education in Canada for 1990 and 1995. Comparing the results between 1995 and 1990, the authors noted the following differences. First of all, the private rates of return to a bachelor's degree increased for men and women, women's rate of return remaining above that of men. The private rate of return from master's and doctoral degrees fell for men and increased for women, and total returns varied in a similar way to private returns.

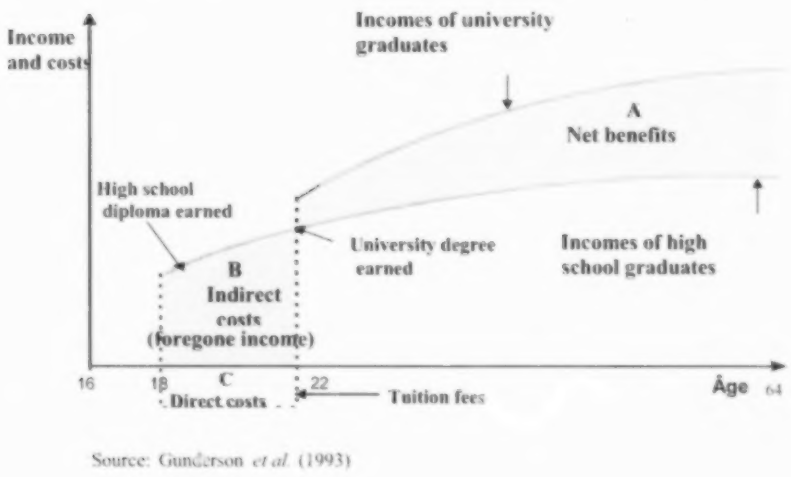
5. Methodological Approach Adopted: Cost-Benefit Analysis

5.1 Methodological Framework

In the last two parts, we discussed the main methods for calculating the cost-effectiveness of education and presented a summary of the main recent Canadian studies. In this part, we clarify the methodological approach adopted in this study.

The approach adopted is based on cost-benefit analysis. According to human capital investment theory and basic investment rules, learning becomes worthwhile where the rate of return is greater than the rate of interest. In addition, if investment projects are optional, one should then choose the one with the highest net present value.

Chart 1
Earnings Profiles of University Graduates, Income and Costs



Source: Gunderson *et al.* (1993)

Chart 1 contains the monetary components considered in the calculation of the private rate of return. Area A represents additional income received by university graduates from the moment they enter the labour market until they retire (a period which has been hypothetically set at between 22 and 64 years). Total costs are given as the total of Areas B and C. Average annual incomes of high school graduates from 18 to 22 years of age (a period in life when young adults

acquire university training) equivalent to the opportunity cost of studying full time for a university education (Area B). Tuition fees are also assumed during university training (Area C). The private rate of return of education r^* is the discount rate at which Area A equals the sum of Areas B and C.

In the study, three time series are developed involving the rates of return of three types of degree/diploma:

(1) the rates of return to non-university post-secondary studies compared to secondary studies (with or without a diplomat) between 1981 and 1996;

(2) the rates of return to a bachelor's degree compared to a high school diploma between 1989 and 1996;

(3) the rates of return to a university degree (including the bachelor's, master's and doctoral degrees) compared to secondary studies (with or without a diploma) between 1981 and 1996.

In addition, since it has been clearly shown in previous studies that the labour market situations of men and women differ and that rates of return to education may therefore vary substantially by gender, rates of return have been evaluated separately.

5.2 Data and Definitions

Rates of return have been estimated using data from the Consumer Finance Survey (CFS). Annual estimates include benefits and direct and indirect costs.

5.2.1 Definition of Benefits

Additional earnings anticipated by the most highly educated are obtained by calculating the difference between earnings received by the least educated and those of high school graduates. Future incomes are based on present incomes because CFS data show a cross-section and are not longitudinal. For example, to evaluate the rates of return on a university degree in 1996, we plotted future earnings profiles based on earnings by discrete age of university graduates in 1996.

The sample used to determine the benefits profile includes the labour income of full-time and part-time employees. It should be noted, however, that the inclusion of part-time employees could accentuate conjectural effects. An alternative method would be to include only full-time

workers in the sample in order to potentially reduce the effects associated with the economic cycle in the measures of rate of return.

We also make the following assumptions:

- Since anticipated incomes are established on the basis of instantaneous measures, we assume that the future incomes of graduates will not be very different from those currently received by their elders. For example, we assume that the anticipated income of a graduate when he is 40 years old will be equal to that currently received by university graduates of the same age.
- The future productivity of graduates will be equal to the productivity of present workers.
- In accordance with the recommendation by Psacharopoulos (1973),[6] we calculate rates of return based solely on labour incomes.

5.3 Indirect Costs

Indirect costs represent the opportunity cost of studying on a full-time basis. During the period of the year devoted to training, students must necessarily forego the income they would receive by working full time. We assume that the incomes students forego during the fall and winter semesters are equivalent to those received by high school graduates between 18 and 22 years of age. At the college level, as length of training is fixed at three years, the opportunity cost is instead allocated between 18 and 21 years.[7] Since students have the opportunity to hold summer jobs from May to August, foregone incomes during the academic year are estimated at 66% of the annual income of high school graduates. In the case of college-level students, the winter trimester ends one month later, which shortens the length of summer jobs by the same length of time. The percentage of the year used to evaluate foregone incomes during college training is thus set at 75%.

[6] According to Psacharopoulos, including income from other sources in the calculation could result in an over-estimation of the value of rates of return because the personal wealth of the more educated could be greater than that of the less educated.

[7] It should be noted that the figures are approximate since the length of studies required to earn secondary and college-level diplomas differs from province to province.

5.4 Direct Costs

Tuition fees in effect during the year of the estimation have been allocated over the number of years required to complete training. Annual tuition fees across Canada for university degrees (including the bachelor's, master's and doctoral degrees) and non-university post-secondary diplomas (including community college and vocational diplomas) come from Statistics Canada. Out-of-pocket expenses for the purchase of books have been arbitrarily set on the basis of the amounts assumed by Vaillancourt (1998) for the 1986 and 1991 census years.

No source of government financial assistance (in the form of student loans or bursaries or tax benefits to parents) has been taken into account. We know that student assistance is not universally provided. Amounts allocated depend on disposable family income. Allocating a fixed amount in respect of financial assistance in evaluating the cost-effectiveness of an education could bias the findings.

5.5 Rate of Return and Economic Situation

According to Lemelin and Prudhomme (1994), the measured or observed rate of return to education, as calculated using the cost-benefit approach, may fluctuate over time because of the economic cycle. If we assume that workers' income, by the various levels of education and years of experience, are proportionately affected by the economic cycle, we should then expect that the observed rate of return is positively associated with the cycle. However, again in the assessment of Lemelin and Prud'homme (1994), it may be considered that this statement is false. For example, in an economic slowdown, it should be expected that the incomes of newly recruited workers and of the less well-educated will be more sensitive to poor economic conditions than those of more educated and experienced workers.

In a number of cases, workers with several years' experience have received a certain form of on-the-job training. This type of training — supplementary or in place of learning done in educational institutions — is characterized as specific investment. Unlike general investment, which is certified by a diploma, specific investment is less readily transferable to another business. Since specific investment cost is generally assumed by the employer, it gives

experienced workers a form of protection from the risk of dismissal during an economic slowdown.

The more frequent dismissals of less qualified workers reduce the average incomes of individuals whose highest qualification is a secondary diploma. The difference between the incomes of the more educated and high school graduates (a component of the rate of return) should therefore grow during recession. In addition, the opportunity cost of full-time studies should also decline since it is based on the wages of relatively unqualified youths, which are largely determined by economic circumstances. Thus, these two factors contribute jointly to increasing the observed rates of return to education measured during an economic slowdown.

Although it has been demonstrated that the economic cycle influences the observed rate of return to education, a distinction must nevertheless be drawn between the measured rate of return and the expected or anticipated rate of return. In the case of expected returns, where expectations are rational, expected future incomes should not depend on economic circumstances since, by definition, the future will be a mix of good and less good circumstances. However, the opportunity cost, which is determined by the present, will be affected by economic circumstances.

6. Findings

In this section, we present our findings regarding the change over time of the rate of return to education by level of education. First, we examine the results of estimates of the profile over time of private rates of return on non-university post-secondary diplomas, the bachelor's degree and university diplomas, which include bachelor's, master's and doctoral degrees. Second, we attempt to evaluate the general trends of the measures of rate of return to education for a university degree by screening the results for the effects of the economic cycle. Third, and lastly, we proceed with a more extensive interpretation of the findings as a whole.

6.1 Changes over Time in the Cost-Effectiveness of Education by Level of Education

The cost-effectiveness of non-university and university post-secondary diplomas/degrees was measured within the interval from 1981 to 1996, with the exception of 1983, which was not covered by the CFS. However, the calculations of the cost-effectiveness of a bachelor's degree can only be done from 1989 onward as a result of changes made to the Labour Force Survey questionnaire, which, since January 1990, has provided information on completed levels of education.[8] For the same reasons, any comparison between the previous year and that following the change relating to non-university post-secondary diplomas must be interpreted with care.[9] Lastly, to maximize the length of the observation period, the following definition of the reference level of education is used: completion of 11 to 13 years of schooling, whether or not certified by a diploma, a broader definition and one referring to the earning of a high school diploma.

6.1.1. Cost-Effectiveness of a Non-University Post-Secondary Diploma or Certificate

The results obtained for the rates of return to a non-university post-secondary diploma are presented in Chart 2 and the table in Appendix A. First of all, as may be seen, the rates of return are positive. We note, however, a significant difference between the private rates of return of

---

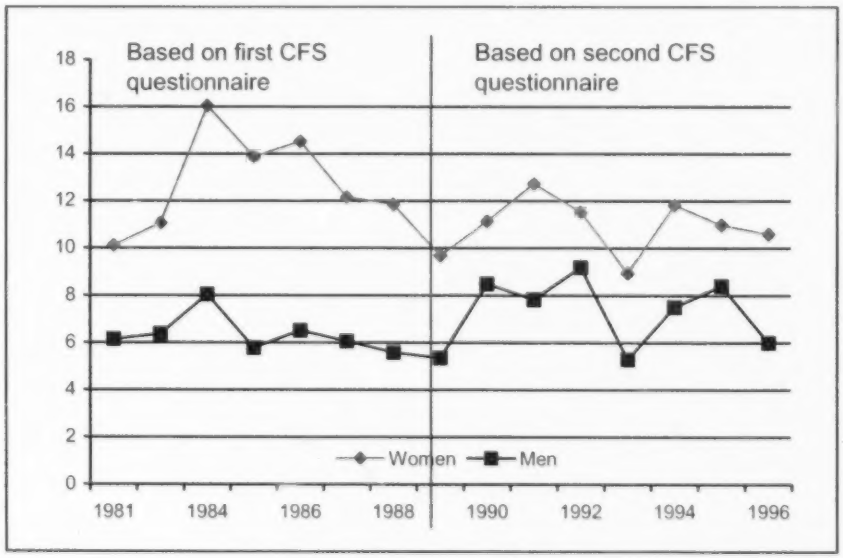
[8] In the old questionnaire, no distinction was drawn between bachelor's, master's and doctoral degrees.

[9] For example, in the old questionnaire, post-secondary training was divided into two certified categories: first, non-university certificates and diplomas and university degrees. In the January 1990 questionnaire, it is divided into professional training, community college, the bachelor's degree, and so on. As should have been expected, this new classification has had an impact on the calculation of average incomes by level of education.

men and women, which is consistent with the findings of previous studies. It is also interesting to note the extent to which the rates of return have tended to fluctuate since the early 1980s, particularly for women. Rates of return also tended to be higher during the recessions of 1981-1982 and 1990-1991, and lower during years of economic expansion. Lastly, although changes in the rate of return between the 1980s and the 1990s must be interpreted with care, it appears the rate for women has followed the downward trend since 1984.

The rate of return to a non-university post-secondary diploma for women reached a peak of 16.0% in 1984 and subsequently trended downward to a low of 8.9% in 1993, a difference of more than seven percentage points between high and low points. According to the most recent observation, the rate of return was 10.6% in 1996. For men, changes in the rate of return have been much more moderate. The rate was quite stable in the 1980s, ranging between 5.3% and 6.5%, except for 1984, when it reached 8%. However, variations were more significant in the 1990s, when the rate of return for men declined from 9.2% in 1992 to 5.3% in 1993. The gap between the highest and lowest rates of return for men is 3.8 percentage points, slightly more than half the gap for women. According to the most recent observations, the rate of return for men was 6% in 1996.

Chart 2
Private Rates of Return to Education
Non-University Post-Secondary Diploma or Certificate
vs. Secondary Studies (with or without diploma), Men and Women (1981-1996)



6.1.2. Cost-Effectiveness of Bachelor's Degree

The results obtained for private rates of return to the bachelor's degree are presented in Chart 3 and the table in Appendix A.

Although the observation period is much shorter for the return to bachelor's degrees, a number of the same conclusions as those pertaining to the non-university post-secondary diploma may be drawn; that is to say that rates of return are positive, higher for women than for men, relatively variable by year, higher following the 1990-1991 recession and lower during years of solid growth. It should be added, however, that the rate of return for men showed a marked downward trend from 1989 onward, falling from a peak of 10.3% in 1989 to a low of 8% in 1995 and rising slightly in 1996 to 8.6%.

There is no clear trend in the case of women. The rate of return was 10.9% at its lowest point in 1990, then rose sharply in 1991 and 1992 to a peak of 12.8%, then fell again thereafter to a more stable level, slightly above 11%.

Table 3 shows the difference in cost-effectiveness between a bachelor's degree and a non-university post-secondary diploma for the period from 1989 to 1996. In the case of men, the rate of return to a bachelor's degree seemed distinctly higher in the 1990s, with the exception of 1995, when the relative return was slightly negative relative to a non-university post-secondary diploma. In the case of women, the difference is somewhat less clear. In three years, 1990, 1991 and 1994, there was a negative difference in rates of return. However, it may be said that, on average, the rate of return for women with a bachelor's degree is greater than that of women with a non-university post-secondary diploma.

Chart 3
Private Rates of Return
Bachelor's Degree vs. Secondary Diploma (1989-1996)

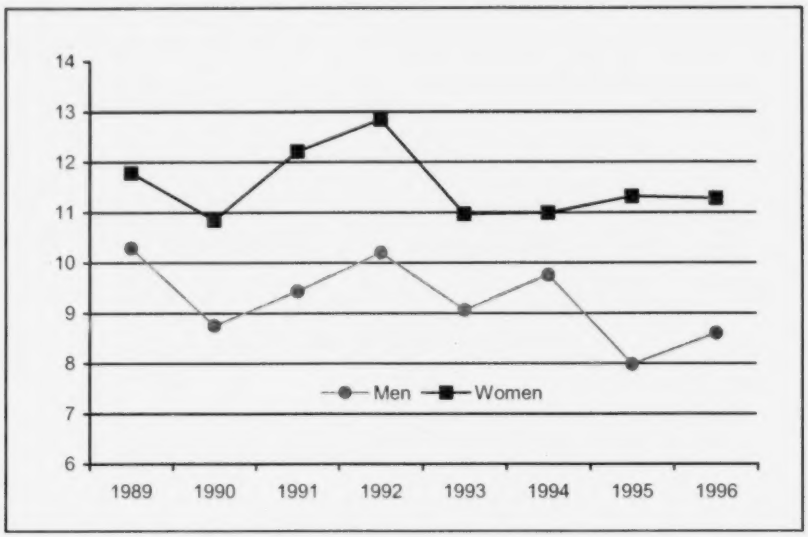


Table 3
Difference in Cost-Effectiveness (Percentage Points)
Bachelor's Degree vs. Non-University Post-Secondary Diploma

Year	Men	Women
1989	5.34	9.67
1990	8.48	11.13
1991	7.82	12.73
1992	9.19	11.52
1993	5.28	8.94
1994	7.51	11.82
1995	8.40	10.97
1996	6.00	
		10.60

6.1.3. Cost-Effectiveness of a University Diploma (Including Bachelor's, Master's and Doctoral Degrees)

The results obtained for private rates of return to a university diploma are presented in Chart 4 and the table in Appendix A.

As in the previous cases, the results show that the rates of return are positive, higher for women than for men and variable with the years. However, there is less variability compared to the rates of return to a non-university post-secondary diploma. In addition, although it is preferable to exclude the cyclical component before drawing any firm conclusion as to the general trend, the

results seem to suggest that the rate of return for men and women has slightly increased since the early 1980s. It is also interesting to note that the correlation between the time series for men and women is high (0.77) for a university degree, which suggests a certain reliability of results. However, it is very low for a non-university post-secondary diploma (0.29). That could be explained by the more appreciable difference between the types of trades selected by men and women with a non-university post-secondary level of schooling, whereas the professions appear to be more homogeneous for men and women with a university degree.

The rate of return for women was at its low point in 1981, 12,2%, then increased to a peak of 15.4% in 1992, a difference of 3.2 percentage points between low and high points. According to the most recent observation, the rate of return was 14.3% in 1996. The rate of return for men who had completed university studies also reached its low point in 1981, at 9.5%, then a peak of 13.5% in 1992, a difference of four percentage points. According to the most recent observation, the rate of return for men was nearly 11% in 1996. It is also interesting to note that, although the rate of return for men correlates with that of women, the most recent observations suggest that the difference in the return increased in 1995 and 1996. One of the explanations for that situation is related to the sharp recovery starting in 1994 in the manufacturing industry, where 70% of employees are men. That recovery resulted in a strong increase in demand for less educated workers, thus contributing to an increase in the opportunity cost of pursuing a post-secondary education and reducing the benefits as measured.

The differences in cost-effectiveness between a university degree and a non-university post-secondary diploma during the period from 1981 to 1996 are compared in Table 4. Rates of return to a university degree for men are still greater than those to a non-university post-secondary diploma during the period examined. The difference varies between 2.7 and 6.9 percentage points. For women, the benefits of a university degree were relatively greater than those of a post-secondary diploma. However, we found that the difference was negative for the sub-period from 1984 to 1986. The negative differences observed between 1984 and 1986 seem minimal, although, when compared to the differences in cost-effectiveness among men for those same years, we note that the differences were significant. The difference among men varied between 4.6 and -1.8 percentage points.

The relative advantage of a university degree over a college diploma may be explained by the fact that anticipated future incomes are higher for university graduates than for community college graduates. Additional income perceived by university graduates is significant enough to offset higher tuition fees and indirect costs (length of training is five years at the university level and three years at the non-university post-secondary level).

Chart 4
Private Rates of Return (%)
University Degree vs. 11 to 13 Years of Schooling to the Secondary Level (1981-1996)

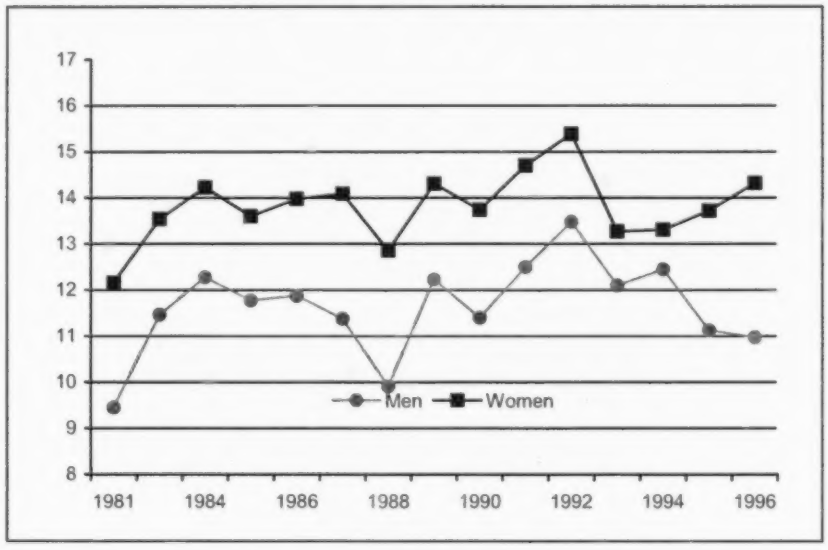


Table 4
Difference in Cost-Effectiveness (Percentage Points)
University Degree vs. Non-University Post-Secondary Diploma

Year	Men	Women
1981	3.3	2.0
1982	5.1	2.5
1984	4.2	-1.8
1985	6.0	-0.3
1986	5.4	-0.5
1987	5.3	1.9
1988	4.3	1.0
1989	6.9	4.6
1990	2.9	2.6
1991	4.7	2.0
1992	4.3	3.9
1993	6.8	4.3
1994	4.9	1.5
1995	2.7	2.7
1996	5.0	3.7

6.2 Correction for Effects of Economic Cycle and Trend

In Part 5.4, we discussed how changes over time in the rate of return to education can be influenced by economic circumstances. We observed in Charts 2 to 4 that the estimated rates of return tended to increase in the 1981-1982 and 1990-1991 recessions and to decline during periods of economic expansion. For this reason, it is difficult to evaluate the trend in changes in rates of return to education without correcting for the effects of the economic cycle. We therefore ran a simple regression relating the rates of return to a university degree for men and women, Rh and Rf, to the unemployment rate for men 25 to 54 years of age, Urh, and to a trend variable.10 That regression should make it possible to check for the presence of a cyclical element and a general trend in the rates of return. The results11 are presented in equations 5 and 6.

10 The unemployment rate of men 25 to 54 years of age is less sensitive to structural shocks affecting the labour market than the overall unemployment rate. Changes in that rate should therefore reflect mainly cyclical shocks.

11 The terms in parentheses represent Student '*t*' statistics.

(5) $$Rh_t = \underset{(7.7)}{7.8} + \underset{(2.8)}{0.49}\,Urh_t - \underset{(-0.6)}{0.1}\,Urh_{t-1} + \underset{(0.8)}{0.24}\log(tendance)$$

(tendance = trend)

$$\overline{R}^2 = 0.47 \qquad D.W. = 2.1$$

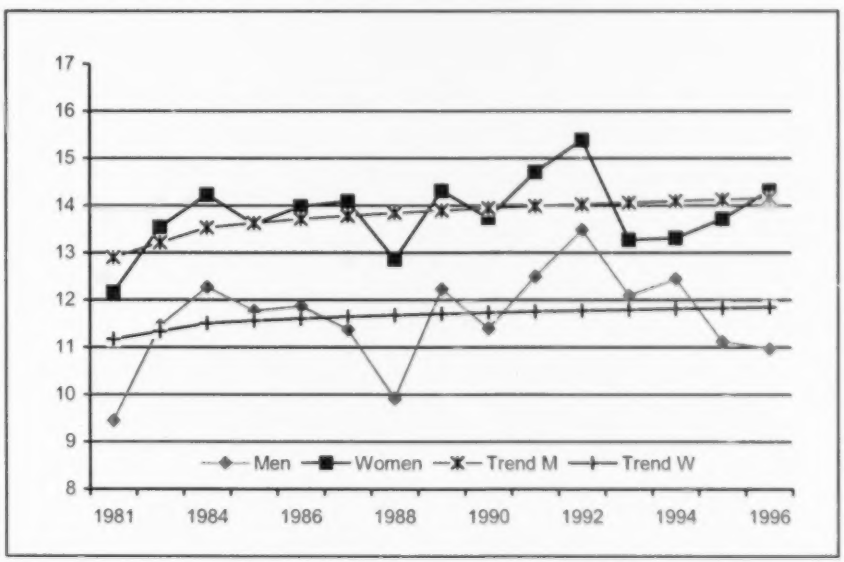
(6) $$Rf_t = \underset{(13.1)}{11.69} + \underset{(2.3)}{0.32}\,Urh_t - \underset{(-1.5)}{0.2}\,Urh_{t-1} + \underset{(1.9)}{0.45}\log(tendance)$$

(tendance = trend)

$$\overline{R}^2 = 0.32 \qquad D.W. = 2.04$$

As the results of equations 5 and 6 emphasize, the cyclical changes in the unemployment rate have a positive effect statistically different from zero on the rates of return for men and women. For women, however, the cyclical effect seems temporary. The regression results are thus based on the assumption of Lemelin and Prud'homme (1994) that the economic cycle has a negative effect on rates of return to education. The results also reveal a slight positive trend in changes in rates of return to a university degree. However, in the case of men, we cannot, from a statistical standpoint, reject the assumption that the slope of the trend is nil. According to the trend results, the private rates of return to a university education increased by approximately one percentage point over the past 20 years (see Chart 5), from 13% to 14.1% for women and from 11.2% to 11.8% for men.

Chart 5
Private Rates of Return (%)
University Degree vs. 11 to 13 Years of Schooling to the Secondary Level (1981-1996)



6.3 Variability of Results by Gender

Based on the results obtained, rates of return to a university degree, a bachelor's degree and a non-university post-secondary diploma were in all cases greater for women than the values observed for men. These results are supported by a number of other studies reporting findings on rates of return to post-secondary education by gender.

At first glance, because of their lower earnings (relative to those of men) and the generally lower rate of activity among women, one would be inclined to believe that the rates of return for women are lower than those for men. And yet we observe the contrary. It will be understood that what is important in evaluating the private rate of return to education is not the absolute value of annual earnings, but rather the additional income received by the most highly educated.

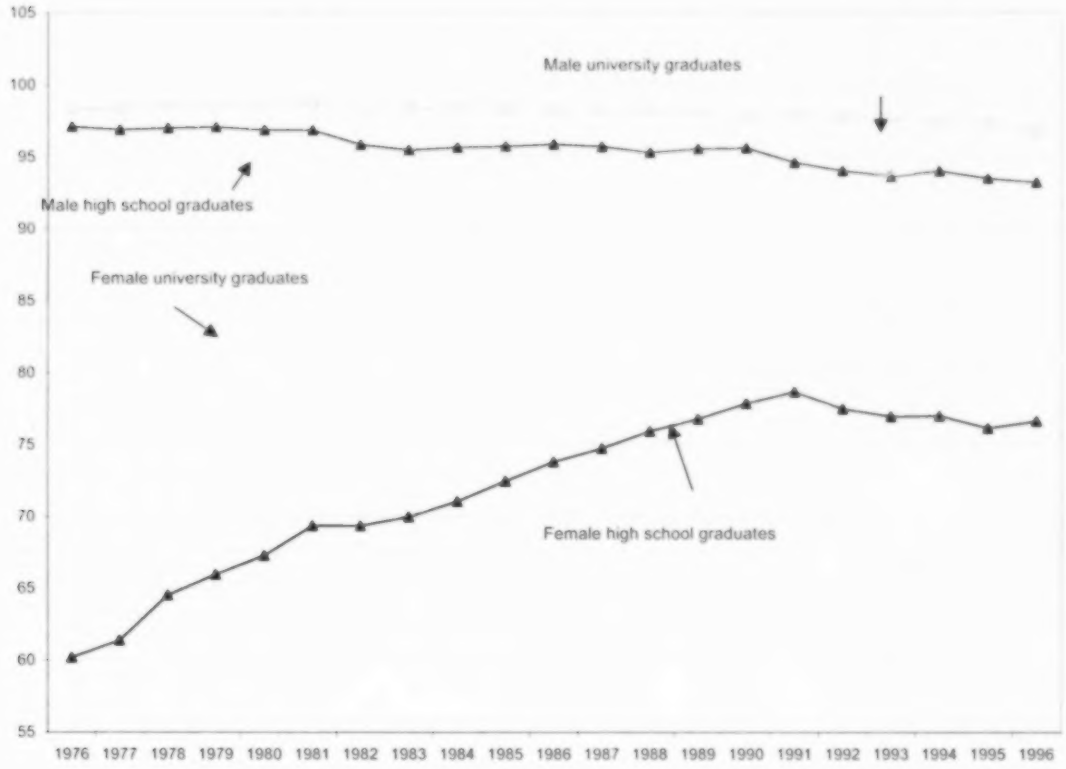
In general, it can be observed that the rate of activity increases with the number of years of schooling. However, the relative difference between the activity rates of the most highly educated women and those of women with high school diplomas is much greater than the relative difference observed among men (see Chart 6, which shows the activity rates of secondary and university graduates, men and women, for the 1976-1996 period). Although there are more women in the labour market than there were previously (regardless of level of education), the most highly educated are more active in the labour market than female high school graduates. As the difference in activity rates between university graduates and high school graduates is greater among women than among men, the additional income to be included in the rate of return will be greater among women.

On the other hand, it is possible that the relative difference between the activity rates of men and those of women may be explained in part by decisions related to fertility, since the opportunity cost of maternity increases with the amount of the salary foregone. That difference might therefore be explained in part by the choices of more educated women not to have as many children.

Another factor that might explain the difference between rates of return to post-secondary education is the difference in opportunity costs. On average, the incomes of women with a high school diploma are lower than those of men, a fact that results in a lower opportunity cost and thus an increase in rates of return. Lastly, the difference could also be explained by factors related to discrimination. According to this explanation, post-secondary education would be a

way for women to protect themselves against discrimination in the labour market, which would have the effect of increasing their rate of return to education.

Chart 6
Rate of Activity by Level of Schooling, Men-Women (1976-1996)



7. Conclusion

The findings as a whole show that the rates of return to post-secondary education are positive, which implies that, on average, investment in human capital is cost-effective for individuals who earn a post-secondary degree or diploma. The level of cost-effectiveness varies, however, by gender and level of education. These findings are also consistent with the Canadian studies estimating the rate of return to education over a single year.

The findings also show that rates of return are sensitive to the state of economic activity. We have examined the measures of rate of return to a university degree and observed that there is a positive correlation between rates of return and unemployment rates. This phenomenon may be explained by an effective rotation of the most highly qualified and experienced labour by employers during economic slowdowns. Firms tend instead to lay off newly recruited and less qualified employees, which has the effect of reducing the value of their average incomes, increasing the relative difference between the incomes of the more highly educated relative to those of the less well educated and to increase the measure of cost effectiveness of a post-secondary degree or diploma in periods of slow economic activity. It should be added that it might perhaps be instructive to break down the total effect of education to distinguish between its effect on weekly income and its effect on number of weeks worked. It might be expected that the least educated experience a pronounced reduction in their opportunity cost during an economic slowdown since the decline in the number of weeks worked would be greater for them.

After screening the data on the basis of economic cycle, the findings reveal a slightly positive trend in rates of return to the university diploma. By our estimates, the trend rates of return increased by approximately one percentage point from the early 1980s. Although this result must be interpreted carefully, this slight upward trend in rates of return to education for university graduates tends to support the assumption that the demand for more highly educated workers increased in the 1980s and 1990s because of growth in sectors of the new knowledge economy[12]

[12] Massé, Roy and Gingras (1998) have shown that, although the number of jobs in sectors requiring a high level of education and knowledge remains proportionately small, those sectors have experienced sharp growth in recent decades.

and that this increase in demand was not fully offset by an adjustment in the supply of educated workers. It is possible, however, that the composition of degrees among university graduates changed between 1981 and 1996 to include more master's and doctoral degree holders. If that is the case, that could explain the positive trend in rates of return measured. Lastly, since the estimated increase in rates of return remains modest, this suggests that Canada is not really suffering from a shortage of skilled labour, a finding consistent with the work of Massé, Roy and Gingras (1998).

Lastly, we would suggest a number of areas for future research. First of all, Appleby *et al.* (2001) have shown that inequalities in the rate of return to post-secondary education are very high depending on individuals and fields of study. It would therefore be good to determine the main reasons for those significant differences in rates of return among individuals and to examine the determining factors in the performance of workers by level of education. Another interesting avenue would be to examine cost-effectiveness over time for the main training disciplines, taking care to identify fields directly or indirectly related to the knowledge economy. This would make it possible to assess the contribution of growth in the knowledge economy to rates of return to education. Another way to take advantage of the time aspect would be to consider the cohort effects on the basis of CFS data, as Beaudry and Green (1991) have done. In addition, most studies, including this one, estimate rates of return to education based on data on past incomes (ex ante). However, it may be assumed that students anticipate costs and benefits on a prospective basis from information available at the time. It would therefore be interesting to evaluate rates of return to education based on student anticipations (ex ante) of the costs and benefits of education.

Appendix A

Table of Main Findings

Private Rates of Return to Post-Secondary Education Relative to a High School Diploma

Year	Post-Secondary Non-University		University Degree		Bachelor's Degree	
	Men	Women	Men	Women	Men	Women
1981	6.14	10.12	9.45	12.16		
1982	6.36	11.05	11.46	13.54		
1984	8.04	16.04	12.27	14.23		
1985	5.77	13.88	11.77	13.60		
1986	6.51	14.52	11.87	13.98		
1987	6.06	12.15	11.37	14.09		
1988	5.58	11.85	9.91	12.86		
1989	5.34	9.67	12.23	14.31	10.29	11.79
1990	8.48	11.13	11.40	13.74	8.75	10.85
1991	7.82	12.73	12.50	14.71	9.43	12.21
1992	9.19	11.52	13.48	15.39	10.20	12.84
1993	5.28	8.94	12.10	13.27	9.06	10.97
1994	7.51	11.82	12.45	13.31	9.76	10.99
1995	8.40	10.97	11.12	13.72	7.98	11.32
1996	6.00	10.60	10.97	14.32	8.60	11.28

Appendix B

Technical Aspects

B.1 Length of Training by Level of Education

Since the term "university degree" includes bachelor's, master's and doctoral degrees, we assume that it takes five years to complete training. That period of time is a convention in the relevant works on the subject.

The average length of training for a bachelor's degree, all fields of study considered, is four years.

A non-university post-secondary diploma can be earned after three years of full-time study.

B.2 Annual Direct Costs by Level of Education

B.2.1 University Degree

University fees represent Canadian average tuition fees incurred, for all fields of study as a whole, and bachelor's, master's and doctoral levels combined. The following table shows the values considered.

Added to university tuition fees are amounts allocated for the purchase of basic books. The following values have been arbitrarily set for the university level: $900/year between 1981 and 1989 and $1,000/year between 1990 and 1996.

Annual Tuition Fees
University Degree (1981-1996)

Year	Average annual tuition fees expressed in current $ for the university level (All degree levels) 1981-1996
1981	796.50
1982	883.50
1984	1,015.30
1985	1,059.10
1986	1,093.90
1987	1,166.70
1988	1,200.50
1989	1,282.40
1990	1,520.10
1991	1,796.30
1992	1,935.00
1993	2,106.00
1994	2,240.40
1995	2,447.00
1996	2,689.30

Source: Statistics Canada

B.2.2 Bachelor's Degree

Annual tuition fees and expenses allocated for book purchases are essentially the same as those assumed for a university degree.

B.2.3 Non-University Post-Secondary Diploma

The annual tuition fee values for the non-university post-secondary level were not available in 1981 or 1982 and were thus arbitrarily set for those two years. However, the data used for 1984 to 1986 are provided by Statistics Canada. Those amounts were paid by full-time students only. The following table shows the values used for the entire observation period.

Direct Costs
Non-University Post-Secondary Diplomas (1981-1996)

Year	Average annual tuition fees expressed in current $ Post-secondary certificate or diploma
	Hypothetical Values
1981	214
1982	300
	Values provided by Statistics Canada
1984	386
1985	472
1986	502
1987	562
1988	607
1989	690
1990	770
1991	851
1992	932
1993	1,060
1994	1,086
1995	1,235
1996	1,385

Source: Statistics Canada

The book expense figures used are: $200 from 1981 to 1988 and $300 from 1989 to 1996.

B.3 Components of Income by Level of Education

B.3.1 University Degree

Availability of Survey Data

To accurately describe the change in rates of return over time, we had to expand our observation window as far as possible. Extending the observation period required us to forego a certain degree of accuracy in the data. For example, gross earnings received solely by master's level graduates could only be observed between 1989 and 1996. In choosing to define the rate of return to a university diploma, without any distinction as to bachelor's, master's or doctoral degree, one could maximize the length of the observation period. As a result of the same type of constraint, the reference level of education is not the high school diploma, but rather 11 to 13 years of education, whether or not certified by a diploma.

Types of Income Composing the Earnings Profile

Gross employment income of full- and part-time employees (including the positive-value incomes of self-employed workers) were used to develop the graduates earnings profiles.

Calculation of Average Income

Average income by level of education was calculated taking into consideration the probability that periods of unemployment will occur during working life. It is generally observed that the most highly educated persons have better working conditions than high school graduates. Not correcting the data in any way to take into account the difficulties of the less educated in entering the labour force and the higher activity rates of the more educated entails the risk of underestimating the incomes of the more educated and underestimating those of the less educated. We therefore evaluated average income by dividing the amount of income received by the holders of a given diploma or degree, not by the number of corresponding salaried workers, but rather by the number of graduates employed or unemployed.

B.3.2 Bachelor's Degree

Types of Income Composing the Earnings Profile

The employment incomes, net of tax payable, of full- and part-time employees (including the positive-value incomes of self-employed workers) were used to prepare the graduates earnings profile.

Calculation of Average Income

Identical to that used for university degrees.

B.3.3. Non-University Post-Secondary Diploma

Types of Income Composing the Earnings Profile

The gross employment incomes of full- or part-time workers (including the positive-value incomes of self-employed workers).

Calculation of Average Income

Identical to that used for university degree.

Bibliography

ALLEN, C. Robert. *Paying for University Education in B.C.*, Centre for Research on Economic and Social Policy, University of British Columbia, Discussion Paper no. 98-07, April 1998.

APPLEBY, John, Dan Boothby, Manon Rouleau and Geoff Rowe. *Rate of Return to Education Using the LifePaths Model*, research paper, Human Resources Development Canada, forthcoming.

BEAUDRY, P., and J. DiNardo. "The Effect of Implicit Contracts on the Movement of Wages over the Business Cycle: Evidence from Micro Data", *Journal of Political Economy*, vol. 99, no. 4, 1991, pp. 665-688.

BEHRMAN, J., Z. Hrubec, P. Taubman, and T. Wales. *Socio Economic Success: A Study of the Effects of Genetic Endowments, Family Environment and Schooling*, Amsterdam, North Holland, 1980.

CARD, D., and T. Lemieux. *Can Falling Supply Explain the Rising Return to College for Younger Men? A Cohort-Based Analysis*, CIRANO, NBER, preliminary version, 1999.

CARNOY, Martin. "Recent Research on Market Returns to Education" in Recent Advances in Measuring the Social and Individual Benefits of Education, *International Journal of Educational Research*, vol. 27, no. 6, 1997, pp. 447-532.

COHN, Elchanan. "The Rate of Return to Schooling in Canada", *Journal of Education Finance*, vol. 23, 1997, pp. 193-206.

COUSINEAU, Jean-Michel. "Le rendement de la scolarité universitaire au Québec" in *Les ressources humaines et la croissance économique*, C. Montmarquette (éd.), Montréal, Cahiers de l'ACFAS, vol. 23, 1984, pp. 61-91.

DE BROUCKER, Patrice, and Laval Lavallée. "Succeeding in Life: The Influence of Parents' Education", Statistics Canada, *Education Quarterly Review*, Catalogue no. 81-003-XPB, vol. 5, no. 1, 1998.

DEMERS, Marius. "La Rentabilité du Diplôme", *Bulletin statistique de l'éducation*, Gouvernement du Québec, Ministère de l'Éducation, Direction des statistiques et des études quantitatives, no. 8, (février 1999).

GUNDERSON, M., and W. Craig Riddell. *Labour Market Economics*, 3rd edition, McGraw-Hill Ryerson, 1993, 746 pp.

JING, Zhongren. *A Spreadsheet Model for Calculating the Economic Returns to Education*, The US Department of Education for OECD INES Project Network B, November 1998.

LEMELIN, Clément. *L'économiste et l'éducation*, Presses de l'Université du Québec, Sainte-Foy (Québec), (1998), 617 pp.

LEMELIN, Clément, et Philippe Prud'homme. "The rate of return de l'éducation et la conjoncture économique: Québec, 1981-87", *L'Actualité économique*, vol. 70, no. 1, 1994, pp. 27-41.

LEMIEUX, T., and D. Card. "Education, Earnings and the Canadian G.I. Bill", *Canadian Economic Review*, vol. 34, no. 2, 2001, pp. 313-344.

LEMIEUX, T., P. Beaudry and D. Parent. *What Is Happening in the Youth Labour Market in Canada?* Centre for the Study of Living Standards, 1999.

MASSÉ, Philippe, Richard Roy and Yves Gingras. *The Changing Skill Structure of Employment in Canada*, Research Paper no. R-99-7E, Human Resources Development Canada, 1998.

MATTILA, J. Peter. "Determinants of Male School Enrollments: A Time-Series Analysis", *Review of Economics and Statistics*, no. 64, 1982, pp. 242-251.

MINCER, Jacob. *Schooling, Experience and Earnings*, National Bureau of Economic Research, New York, 1974.

MINISTÈRE DE L'ÉDUCATION DU QUÉBEC : « L'éducation… Oui c'est payant! ». Bulletin statistique de l'éducation, No 16, (2000), 9 p.

OECD. CENTRE FOR EDUCATIONAL RESEARCH AND INNOVATION. *Human Capital Investment – An International Comparison*, 1998.

PHILLIPS, J., H.L. Votey, Jr. and D. Maxwell. "Crime, Youth, and the Labor Market", *Journal of Political Economy*, May-June, Part 1, 1980.

PSACHAROPOULOS, Georges. "Returns to Investment in Education: A Global Update", *World Development*, vol. 22, no. 9, pp. 1325-1343, 1994.

PSACHAROPOULOS, Georges. *Returns to Education: An International Comparison*, Jossey-Bass Inc. Publishers, Elsevier Scientific Publishing Company, 1973, 216 pp.

PSACHAROPOULOS, Georges, and Y.C. Ng. "Earnings and Education in Latin America: Assessing Priorities for Schooling Investments", *Education Economics*, vol. 2, no. 2, 1994.

STAGER, A., and A. David. *Returns to Investment in Ontario University Education, 1960-1990 and Implications for Tuition Fee Policy*, Council of Ontario Universities, Ontario, December 1994.

VAILLANCOURT, François. *The Private and Total Returns to Education in Canada, 1990*, Centre de recherche et développement in économique (CRDE), Université de Montréal, December 1996.

VAILLANCOURT, François. *The Returns to Education in Canada: 1985 and 1990*, Centre de recherche et développement in économique (CRDE), Université de Montréal, 1998.

VAILLANCOURT, François, et Sandrine Bourdeau-Primeau. *The Returns to Education in Canada: 1990 and 1995*, Centre de recherche et développement in économique (CRDE), Université de Montréal, 2001.